

# ILNAS

Institut luxembourgeois de la normalisation  
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**ILNAS-EN 1993-4-1:2007/A1:2017**

## **Eurocode 3 - Design of steel structures - Part 4-1: Silos**

Eurocode 3 - Calcul des structures en  
acier - Partie 4-1 : Silos

Eurocode 3 - Bemessung und  
Konstruktion von Stahlbauten - Teil 4-1:  
Silos

**06/2017**



## National Foreword

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ILNAS-EN 1993-4-1:2007/A1:2017

EUROPEAN STANDARD **EN 1993-4-1:2007/A1**

NORME EUROPÉENNE

EUROPÄISCHE NORM

June 2017

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English Version

## Eurocode 3 - Design of steel structures - Part 4-1: Silos

Eurocode 3 - Calcul des structures en acier - Partie 4-1 :  
Silos

Eurocode 3 - Bemessung und Konstruktion von  
Stahlbauten - Teil 4-1: Silos

This amendment A1 modifies the European Standard EN 1993-4-1:2007; it was approved by CEN on 3 March 2017.

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COMITÉ EUROPÉEN DE NORMALISATION  
EUROPÄISCHES KOMITEE FÜR NORMUNG

**CEN-CENELEC Management Centre: Avenue Marnix 17, B-1000 Brussels**

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## European foreword

This document (EN 1993-4-1:2007/A1:2017) has been prepared by Technical Committee CEN/TC 250 “Structural Eurocodes”, the secretariat of which is held by BSI.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by June 2018, and conflicting national standards shall be withdrawn at the latest by June 2018.

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## 1 Modification to the Foreword

In the Section "National Annex for EN1993-4-1", replace the following entry:

- "
- 6.3.2.7 (3)"

with:

- "
- 6.3.2.7 (4)".

## 2 Modifications to 1.2, Normative references

In the entry dedicated to EN 1990, replace "EN 1990" with "EN 1990:2002" and replace the title of this reference with "Eurocode – Basis of structural design".

In the entry dedicated to EN 1993, in the list, replace "Part 1.6:" with "Part 1.6:2007:".

## 3 Modification to 1.6.1, Roman upper case letters

Replace:

" $R_{\phi}$  local radius at the crest or trough of a corrugation."

with:

" $r_{\phi}$  local radius at the crest or trough of a corrugation.".

## 4 Modification to 1.6.2, Roman lower case letters

Replace:

" $\ell$  wavelength of a corrugation in corrugated sheeting;"

with:

" $l$  wavelength of a corrugation in corrugated sheeting;".

## 5 Modification to 2.7, Modelling of the silo for determining action effects

Replace Paragraph (1)P with:

"(1)P The general requirements set out in EN 1990 shall be followed."

## 6 Modification to 2.9.1, General

Replace Paragraph (1)P with:

"(1)P The general requirements set out in EN 1990 shall be satisfied."

## 7 Modification to 2.9.2.2, Partial factors for resistances

Add two new Paragraphs (4) and (5) after Paragraph (3)P:

"(4) Where hot rolled steel sections are used as part of a silo structure, the relevant partial factors for resistance should be taken from EN 1993-1-1.

(5) Where cold-formed steel sections are used as part of a silo structure, the relevant partial factors for resistance should be taken from EN 1993-1-3."

## 8 Modification to 2.10, Durability

Replace Paragraph (1) with:

"(1) The general requirements set out in 2.4 of EN 1990:2002 should be followed."

## 9 Modification to 4.2.2.1, General

After Paragraph (2), add the following new Paragraphs (3) to (6):

"(3) Where the silo is subject to any form of unsymmetrical bulk solids loading (patch loads, eccentric discharge, unsymmetrical filling etc.), the structural model should be designed to capture the membrane shear transmission within the silo wall and between the wall and rings.

NOTE The shear transmission between parts of the wall and rings has special importance in construction using bolts or other discrete connectors (e.g. between the wall and hopper, between the cylinder wall and vertical stiffeners or support, and between different strakes of the cylinder).

(4) Where a ring girder is used to redistribute silo wall forces into discrete supports, and where bolts or discrete connectors are used to join the structural elements, the shear transmission between the parts of the ring due to shell bending and ring girder bending phenomena should be determined.

(5) The stiffness of the stored bulk solid in resisting wall deformations or in increasing the buckling resistance of the shell structure should only be considered where a rational analysis is used and there is clear evidence that the solid against the wall is not in motion at the specified location during discharge. In such situations, the relevant information on the flow pattern, the pressure in the solid and the properties of the specific stored bulk solid should be determined from EN 1991-4.

(6) Where a corrugated silo exhibits mass flow, the solid held stationary within the corrugations should not be considered as stationary in (5)."

## 10 Modification to 4.2.2.3, Consequence Class 2

Delete the following Paragraphs (10) to (12):

"(10) Where the silo is subject to any form of unsymmetrical bulk solids loading (patch loads, eccentric discharge, unsymmetrical filling etc.), the structural model should be designed to capture the membrane shear transmission within the silo wall and between the wall and rings.

NOTE The shear transmission between parts of the wall and rings has special importance in construction using bolts or other discrete connectors (e.g. between the wall and hopper, between different strakes of the barrel).

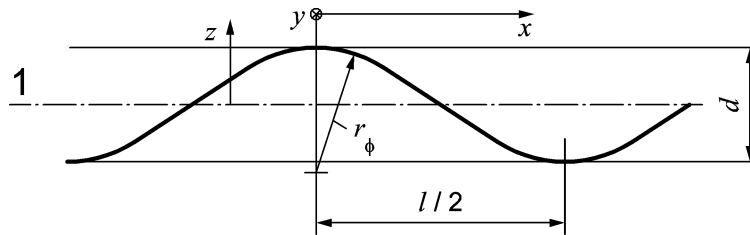
(11) Where a ring girder is used to redistribute silo wall forces into discrete supports, and where bolts or discrete connectors are used to join the structural elements, the shear transmission between the parts of the ring due to shell bending and ring girder bending phenomena should be determined.

(12) Except where a rational analysis is used and there is clear evidence that the solid against the wall is not in motion during discharge, the stiffness of the bulk solid in resisting wall deformations or in increasing the buckling resistance of the structure should not be considered."

**11 Modifications to 4.4, Equivalent orthotropic properties of corrugated sheeting**

Replace Figure 4.2 with:

"



**Key**

1 effective middle surface

**Figure 4.2 — Corrugation profile and geometric parameters**

"

Replace the notation lines in Paragraph (3) with:

"where:

- $d$  is the crest to crest dimension;
- $l$  is the wavelength of the corrugation;
- $r_{\phi}$  is the local radius at the crest or trough."

Replace Paragraph (4):

"(4) All properties may be treated as one-dimensional, giving no Poisson effects between different directions."

with:

"(4) The equivalent properties of the sheeting in each of the two principal directions may be treated as independent, so that strains in one direction do not produce stresses in the orthogonal direction (i.e. no Poisson effects)."

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